

Project 2 Report

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1 User Guide

Included with this project are the following two MATLAB files:

- project2main.m
- ConjugateGradientPDE_2D.m

project2main.m is a script which solves exactly what the specs are asking for, that is:

1. Solves the equation $-u_{xx} - u_{yy} + e^{x+y}u = 1$ for $N = 32, 64, 128, 256, 512$.
2. Plots the five graphs, one for each N .
3. Examines the relationship between N and the number of iterations required to obtain the solution.

ConjugateGradientPDE_2D.m is the function that solves the equation

$$-u_{xx} - u_{yy} + q(x, y)u = r(x, y)$$

It has the following input variables in respective order:

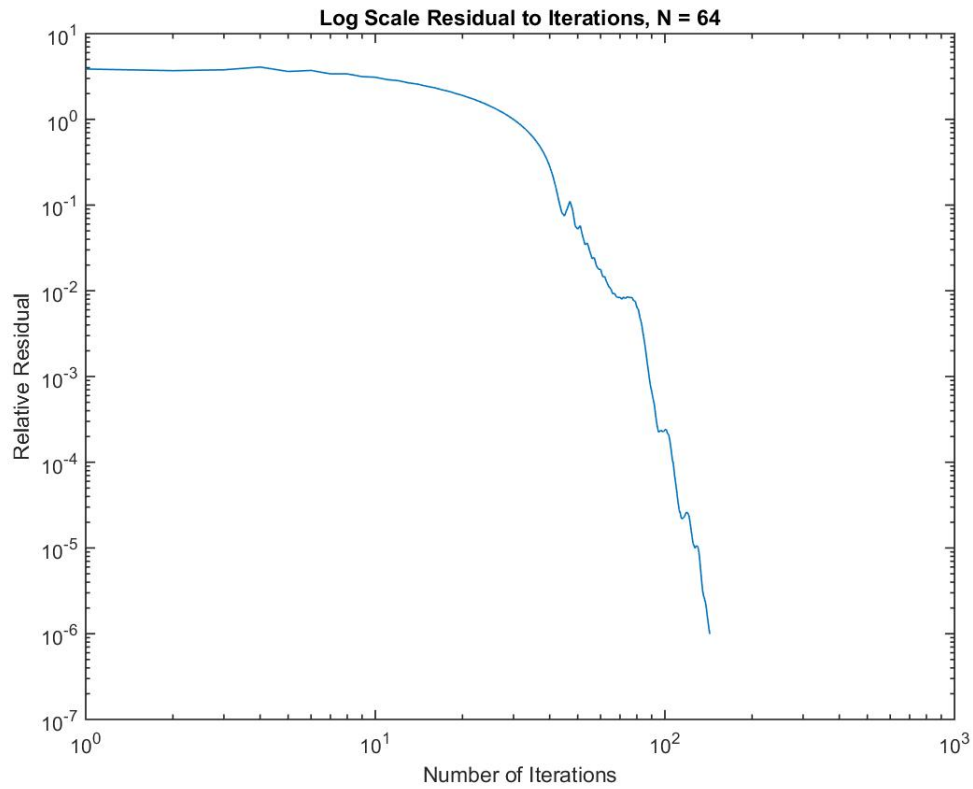
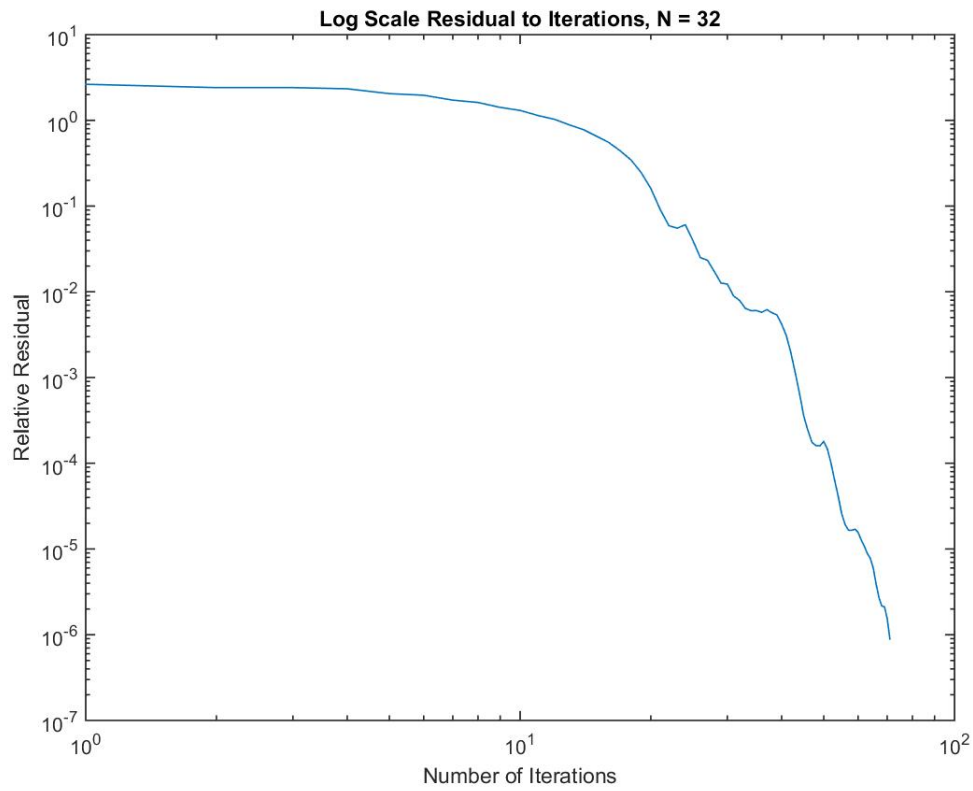
- q_xy: Function $q(x, y)$ of the equation
- r_xy: Function $r(x, y)$ of the equation
- N: Size of partition of domain
- TOL: Threshold value for relative residual
- Iteration: Maximum number of iterations until program terminates

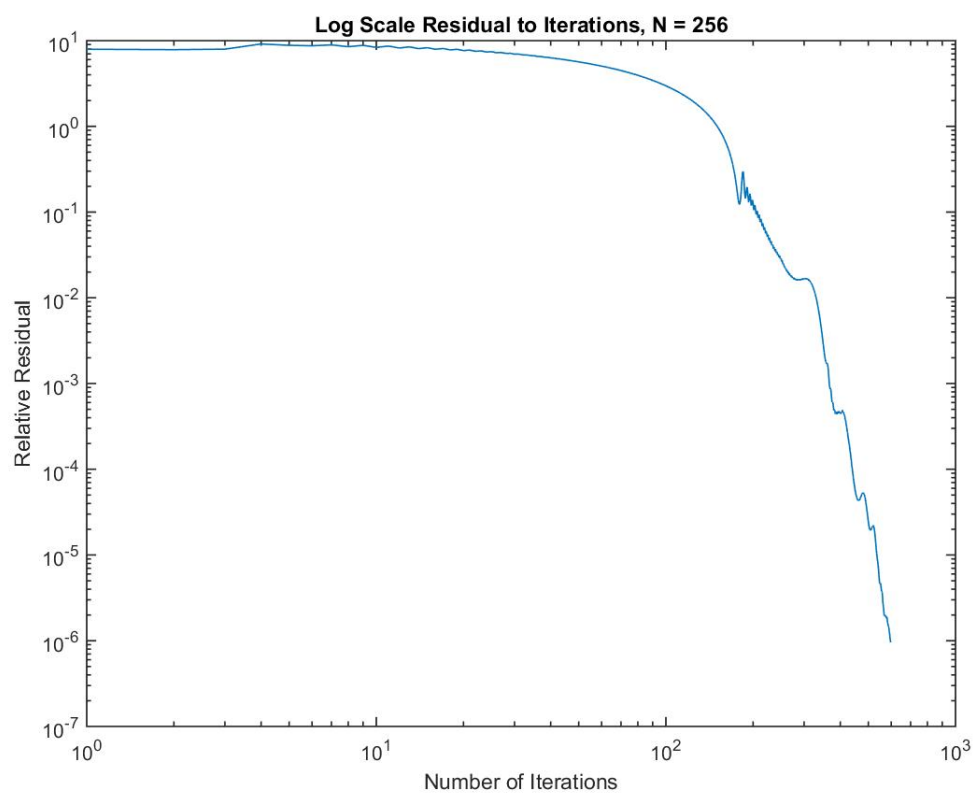
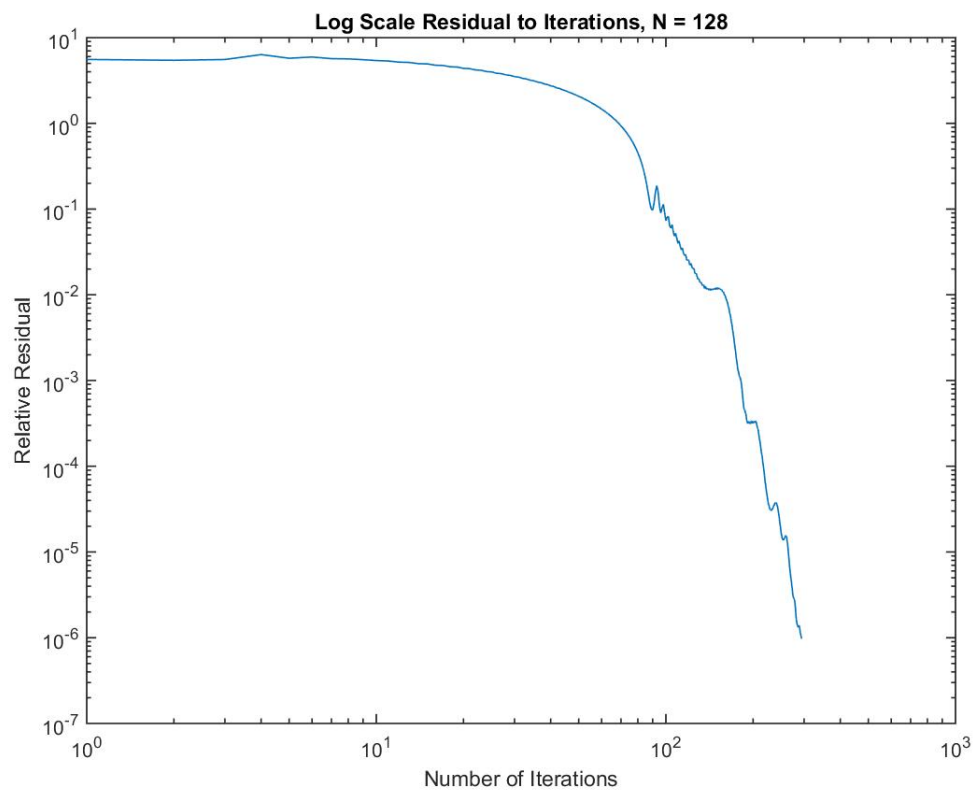
And the following outputs in respective order:

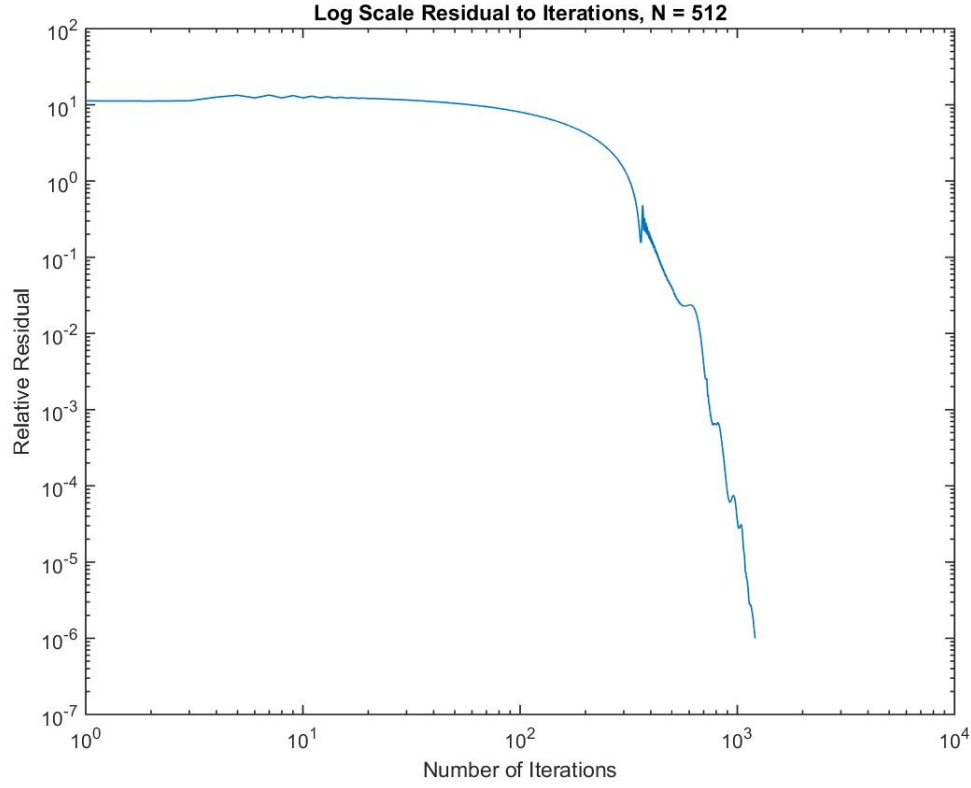
- u: Solution matrix of size $(N - 1) \times (N - 1)$.
- k: Number of iterations required to obtain u.

2 Solutions

The plots of the graphs are shown below and on the next pages:







The table below shows how many iterations each N needed:

N	32	64	128	256	512
k	71	143	294	597	1208

3 Discussion

An obvious relationship can be seen just by examining the table in the solutions section. As N increases, the number of iterations k also increases, approximately at the same rate as N . Below is the Logarithmic Scaled graph of k and N and describes an increasing linear slope:

